CMFRI

Winter School on

Impact of Climate Change on Indian Marine Fisheries

Lecture Notes

Part 1

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Evidences for Climate Change

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Introduction

The climate of the earth is always changing. In the past it has altered as a result of natural causes. Nowadays, however, the term climate change is generally used when referring to changes in our climate, which have been identified since the early part of the 1900's. The changes we have seen over recent years and those, which are predicted over the next 80 years, are thought to be mainly as a result of human behaviour rather than due to natural changes in the atmosphere.

The greenhouse gases are very important when we talk about climate change as it relates to the gases, which keep the earth warm. It is the extra greenhouse gases, which humans have released pose the strongest threat.

Scientific evidences for climate change have been assembled by two main agencies viz., the IPCC (Inter-governmental Panel on Climate Change and the UN FCCC – United Nations Framework Convention on Climate Change) based on investigations carried out by a large number of researchers from all over the world. This heightened activity has resulted in the development of a new branch of science called climate change science. Following is a brief account of the major evidences reported by scientists to reveal the existence of climate change. As with any new branch of science, sceptics about climate change also abound, but these groups are being pushed into a corner by the increasing evidences.

A few evidences

1. Receding glaciers: Mountain glaciers and snow cover have declined in both hemispheres and widespread decreases in glaciers and ice caps have contributed to sea level rise. New data evaluated by the IPCC shows that losses from the ice sheets of Greenland and Antarctica have very likely contributed to sea level rise from 1993 to 2003. The average global sea level rose at an average rate of 1.8 mm per year between 1961 and 2003, but between 1993 and 2003 it rose by 3.1 mm per year. Almost all mountain glaciers in the world are now melting, many of them quite rapidly. Some example are: Mount Kilimanjaro (Africa), Himalayas, Swiss Alps, Patagonia (Argentina).
2. Ice-core data collected by glaciologists shows that average yearly temperatures has been climbing for the past 650,000 years. The hottest year recorded during this entire period was 2005.
3. Glaciologists have also looked at the tiny air bubbles trapped in the ice cores to measure the CO_2 concentrations over a very long period. The atmospheric CO_2 levels have reached un-scaled peaks in recent years.
4. Because of drier soil and leaves due to higher average temperatures, wildfires are becoming much more common. In addition, warmer air causes more lightning, another cause for fire. There is evidence for this happening in every continent.
5. Increasing occurrence of cyclones and hurricanes: Warmer water near ocean surface fuels more frequent and big ocean storms (hurricanes, cyclones and typhoons). These storms are also occurring in parts of the world where they never used to occur. In the USA, the all-time record for tornados (inland storms) was broken in 2004.
6. Occurrence of extreme or extra-strength weather: Warmer temperatures mean greater evaporation, and a warmer atmosphere is able to hold more moisture — hence there is more water aloft that can

fall as precipitation. Similarly, dry regions are apt to lose still more moisture if the weather is hotter; this exacerbates droughts and desertification.

- The frequency of heavy precipitation events has increased over most land areas. Significantly increased precipitation has been observed in eastern parts of North and South America, northern Europe and northern and central and south Asia. For e.g., the Mumbai floods of July 2005, when 94 cm of rain poured in 24 hours.
- Drought has also been observed over large regions, i.e. the Sahel, the Mediterranean, southern Africa and parts of southern Asia.
- In Africa's large catchment basins of Niger, Lake Chad, and Senegal, total available water has decreased by 40 to 60 per cent, and desertification has been worsened by lower average annual rainfall, runoff, and soil moisture, especially in southern, northern, and western Africa.
- The Rhine floods of 1996 and 1997, the Chinese floods of 1998, the East European floods of 1998 and 2002, the Mozambique and European floods of 2000, and the monsoon-based flooding of 2004 in Bangladesh (which left 60 per cent of the country under water), are examples of more powerful storms.

7. The decline of winter: There are two places on earth that are especially vulnerable to global warming – the Arctic and Antarctica. Changes in both areas are happening sooner and more dramatically than anywhere else. Average Arctic temperatures increased at almost twice the global rate in the past 100 years. Temperatures at the top of the permafrost layer have generally increased since the 1980s by up to 3°C. In the Russian Arctic, buildings are collapsing because permafrost under their foundations has melted.
8. Shifts in natural world: Scientists have observed climate-induced changes in at least 420 physical processes and biological species or communities. For example:
   - In the Alps, some plant species have been migrating upward by one to four meters per decade, and some plants previously found only on mountaintops have disappeared.
   - Instances of coral reef bleaching due to higher temperatures are increasingly observed.
   - Increased occurrence of algal blooms. In the Baltic Sea, in northern Europe many resorts had to close during the summer of 2005 because of algae.

Future Effects

Scientific understanding and computer models have improved recently and many projections can now be made with greater certainty.

- The minimum warming forecast for the next 100 years is more than twice the 0.6°C increase that has occurred since 1900, and that earlier increase is already having marked consequences.
- In its Fourth Assessment Report, the IPCC states that the contraction of the Greenland ice sheet is projected to continue to contribute to sea level rise after 2100. If this contraction is sustained for centuries, that would lead to the virtually complete elimination of the Greenland ice sheet and a resulting contribution to sea level rise of about 7 m.
- Salt-water intrusion from rising sea levels will reduce the quality and quantity of freshwater supplies. This is a major concern, since billions of people already lack access to freshwater. Higher ocean levels already are contaminating underground water sources in Israel and Thailand, in various small island states in the Pacific and Indian Oceans and the Caribbean Sea, and in some of the world's most productive deltas, such as China's Yangtze Delta and Vietnam's Mekong Delta.

- A future of more severe storms and floods along the world's increasingly crowded coastlines is likely, and will be a bad combination even under the minimum scenarios forecast. Furthermore, extra-tropical storm tracks are projected to move poleward, with consequent changes in wind, precipitation, and temperature patterns, continuing the pattern observed over the last half century.
- Most of the world's endangered species - some 25 per cent of mammals and 12 per cent of birds - may become extinct over the next few decades as warmer conditions alter the forests, wetlands, and rangelands they depend on, and human development blocks them from migrating elsewhere.
- Higher temperatures are expected to expand the range of some dangerous "vector-borne" diseases, such as malaria, which already kills 1 million people annually, most of them children.

Evidences against climate change

Some scientists disagree with the global predictions for climate change, mainly because the climate had changed naturally before. In addition predicting changes to our climate is very complex and the use of computer models has raised some criticism.

On top of that, some experts believe that it is impossible to be certain about how our climate will change, as it can be very unpredictable. They also believe, the climate is supposed to change and it has done before. Many believe activities from humans cannot be blamed for changes in the climate.

The Cambridge based European Science and Environment Forum released an American report about climate change in February 2002. The report concluded that projections of climate change by the IPCC were based on unknown assumptions about the future and based on computer models, which are not adequate for such a job. However, IPCC, in its fourth report states that the climate change, which occurs now, can be claimed as human-induced with 85% certainty.